



## **Petroleum Remediation Program**

Minnesota Pollution Control Agency

[http://www.pca.state.mn.us/programs/lust\\_p.html](http://www.pca.state.mn.us/programs/lust_p.html)

### **LAND TREATMENT GENERAL INFORMATION**

Guidance Document 3-15

Land treatment is a natural, safe and effective method of treating petroleum contaminated soil. This document explains the process.

#### **The Minnesota Pollution Control Agency's (MPCA) Petroleum Remediation Program**

The Petroleum Remediation Program began in 1987 and has focused on cleaning up tank releases and preventing new leaks of petroleum products. Because of the sheer number of leaking tanks and the serious problems caused by some of these leaks, prompt risk evaluation and possible cleanup has been an agency priority.

#### **Where does petroleum contaminated soil come from?**

Tanks containing petroleum products are found in a variety of places. Many homes, apartment buildings, schools and businesses are heated with fuel from underground or aboveground storage tanks. Gas stations, airports and farms store gasoline and diesel fuel in underground and aboveground storage tanks. Bulk facilities dispensing petroleum products often store petroleum products in large aboveground storage tanks.

Petroleum contaminated soil may be removed from these areas following releases from either the tanks or piping.

#### **Why are these tanks leaking?**

Petroleum products are released to their environment in a number of ways. Corrosion of bare steel underground storage tanks and pipes creates small holes or cracks that can lead to significant levels of contamination. Improper filling and dispensing operations are a common source of contamination. In addition, improper installation of tanks and piping account for a significant number of petroleum releases.

Regulations for all tanks effective December 22, 1998 prevent releases by requiring all tanks to have spill, overfill, and corrosion protection.

#### **Why is it necessary to remove petroleum contaminated soil?**

Petroleum contaminated soil is removed and treated if it appears to pose a threat if left in the ground. In some cases, vapors from released petroleum have entered sewers and basements, resulting in fires and explosions. City and private water supplies may become contaminated if they come in contact with petroleum contaminated soil or released petroleum products (see Figure 1 at the top of the next page).

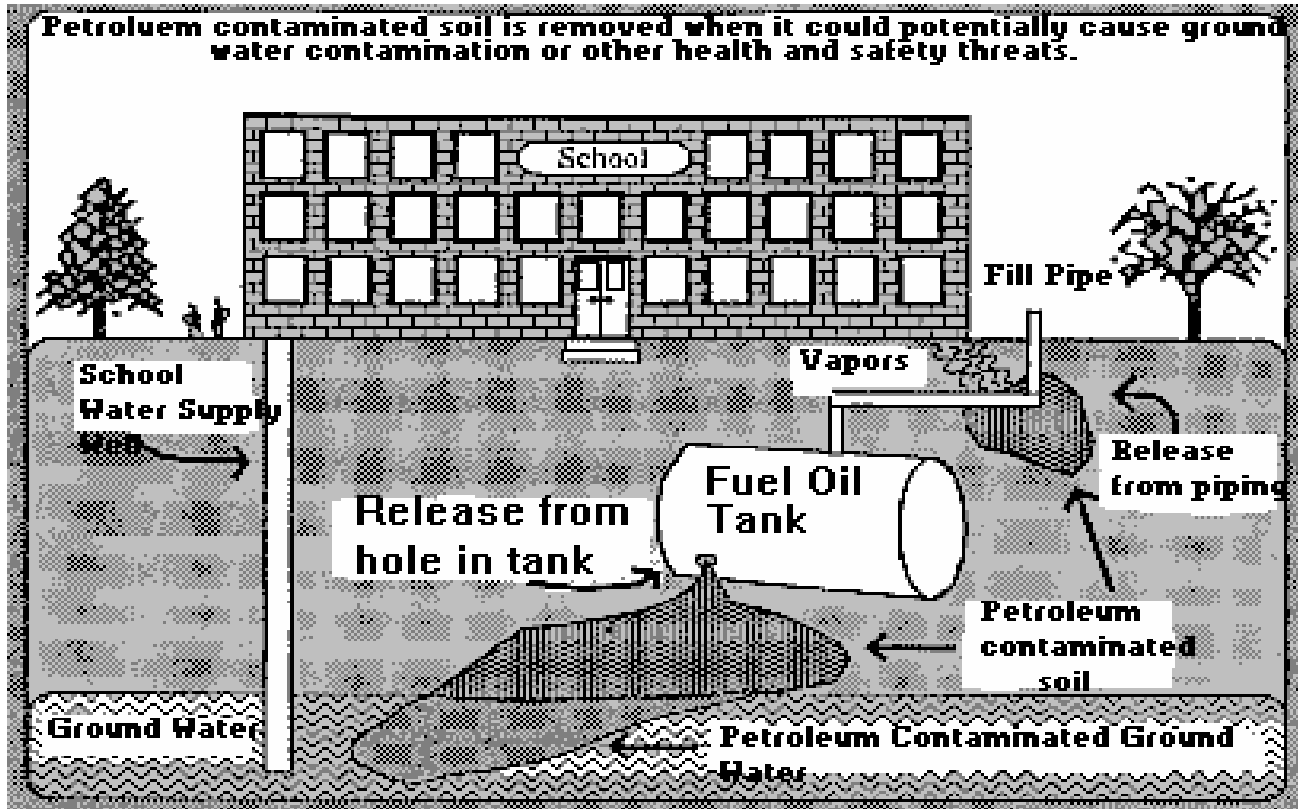


Figure 1

### **Petroleum contaminated soil: what's in it?**

Petroleum is a naturally occurring substance formed by the heating and compression of ancient plant and animal matter over millions of years. Petroleum can be refined into products that we commonly use such as gasoline, kerosene, heating, diesel fuels, etc. Petroleum contamination is measured through field and laboratory analysis in milligrams per kilogram (mg/kg; sometimes called parts per million, or ppm) of Gasoline Range Organics (GRO) and/or Diesel Range Organics (DRO) present in the soil.

MPCA data indicate an average GRO and/or DRO concentration of 1,000 ppm for soils excavated and land applied in Minnesota. This amount is approximately four cups of petroleum product in one cubic yard of soil. The soil is not saturated with petroleum, but often appears stained, especially with fuel oil, and has a distinct petroleum odor (the average human nose is sensitive to gasoline odors down to one ppm).

### **Lead and petroleum contaminated soil**

A number of questions posed to the MPCA are on the subject of lead contained in petroleum contaminated soil and the possibility of it adversely affecting people or plants. According to the Agricultural Extension Service at the University of Minnesota, exposure to lead generally occurs through consumption of soil contaminated with lead or dust contaminated with lead. The two main sources of lead contaminated soil are from buildings where lead-based paint has chipped off into the nearby soil and lead from auto emissions which accumulates in soil near major streets and high ways.

Children run the highest risk of being adversely affected by soil contaminated by lead, not only because they are more susceptible to the absorption of lead, but also because they are more likely to consume it. The toxic level of lead in children has been estimated to be 1,000 micrograms of lead per day for over

four months. This translates into approximately one-half teaspoon of soil contaminated with greater than 500 ppm of lead consumed per day over the period of four to six months. Since plants do not take up or accumulate large quantities of lead, it is considered safe to consume produce that is grown in soil with total lead levels of less than 500 ppm.

MPCA rules on land treatment do not allow the total lead concentration at a land treatment site to exceed 300 ppm. Besides being safely below the 500 ppm threshold indicated by the Agricultural Extension Service, some native soils are found to contain lead levels of up to 300 ppm. In addition, the MPCA strongly recommends a minimum organic content of two percent in the native soil. These organic compounds bind lead to them, making it even less available to plants.

### Mercury and petroleum contaminated soil

The main sources of mercury are improper disposal of batteries and mercury-containing light bulbs. Mercury is not a component of petroleum products.

### What is land treatment and how does it work?

Excavated soil from a leak or spill is transported to agricultural land which has been approved by the MPCA as a land treatment site (land treatment should not be confused with landfilling or indiscriminate dumping). The soil is then spread out over the approved site at a thickness no greater than four inches and incorporated into the upper four to six inches of topsoil by disking or tilling with conventional farm equipment.

Once the soil is incorporated, the petroleum components attach physically to the soil particles and are available to the naturally occurring microorganisms, such as bacteria and fungi (see Table 1.). These organisms break down the petroleum wastes by consuming them and transforming them into harmless substances consisting mainly of carbon dioxide, water and fatty acids. The petroleum components are also broken down chemically sunlight and oxygen if the soil is being tilled on a monthly basis.

It is important to realize that these processes are not as effective when contaminated soil is simply left underground because the majority of the organisms that target the petroleum as food are aerobic and need the oxygen and organic matter present in the topsoil to survive. Sometimes nutrients are added to the soil to provide an optimal environment for rapid microbial growth. The population of these organisms naturally declines as the nutrients and petroleum contamination decrease, in the soil.

Table 1

Organisms Commonly Found in the Soil	
Organism*	Estimated numbers ** per gram of soil
Bacteria	3,000,000 to 500,000,000
Actinomycetes	1,000,000 to 20,000,000
Fungi	5,000 to 900,000
Yeasts	1,000 to 100,000
Algae	1,000 to 500,000
Protozoa	1,000 to 500,000
Nematodes	50 to 200

\* There are also large numbers of slime molds, virus phages, insects, worms, anthropods and mycoplasma.  
\* Numbers are based on plate counts.

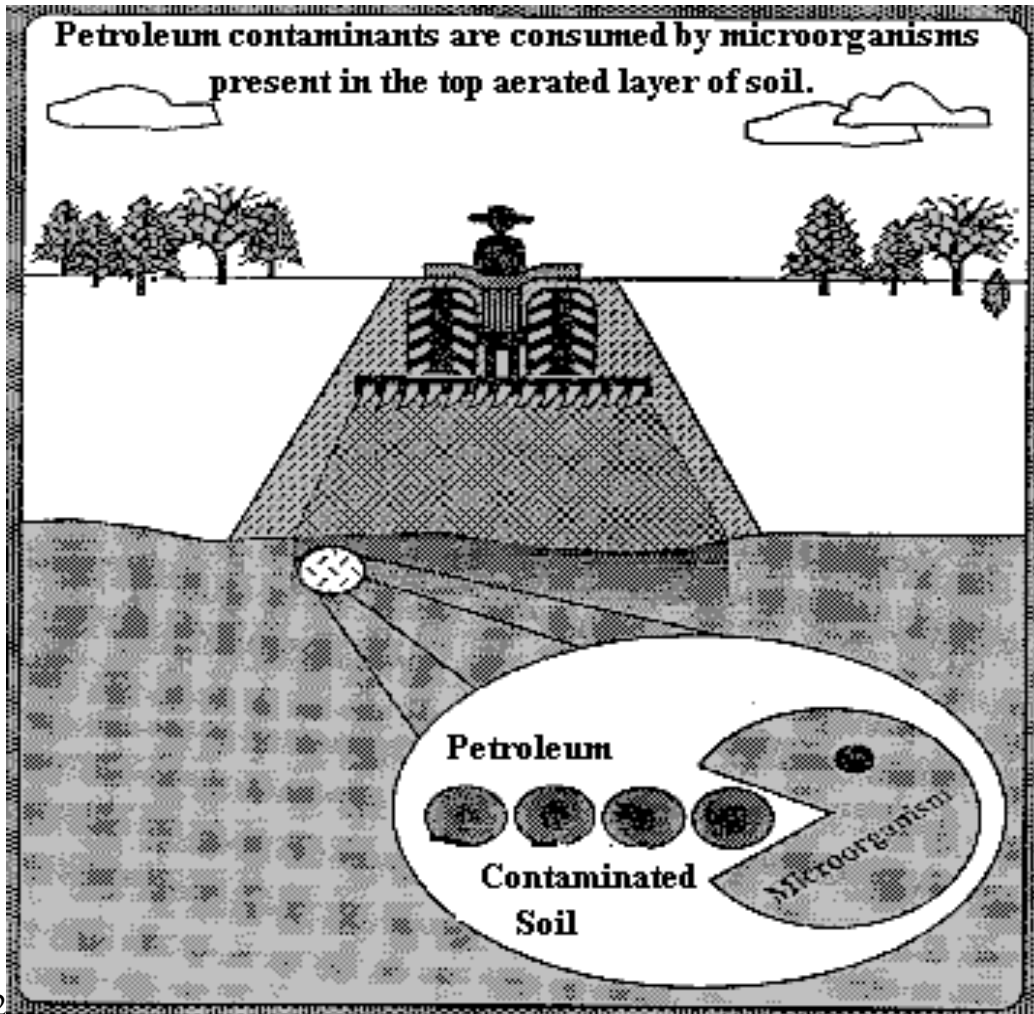


Figure 2

### How does the MPCA oversee the land treatment process?

A common misconception about land treatment is that it involves wholesale dumping of hazardous substances on farmland. The reality is that the MPCA has strict guidelines to regulate the practice. Anyone who wishes to land apply petroleum contaminated soil must submit a land treatment application and receive an approval letter from MPCA staff.

Some of the information required in an application for land treatment includes: contaminated soil types, levels of contamination and volume, native soil characteristics, location and quality of surface and ground water, geology and topography of the site, proximity to drinking water wells, adjoining properties, and environmentally sensitive areas such as wetlands. The applicant must also notify the county, and the city or township, and include written approval from the township if the soil to be land spread is coming from outside that township.

Staff at the MPCA review all applications thoroughly to make sure all rule requirements are met. The approval letter is not a blanket permit to do land treatment. Each MPCA letter of approval relates to a specific volume of soil approved for land treatment on a specific area of land. MPCA approvals do not relieve applicants from their duty to comply with any local ordinances that apply to them, nor does the approval supersede any local ordinances.

Once the land treatment site is approved, the soil is spread, and the site is tilled on a monthly basis or seeded to a non-root crop which will not be used for human consumption. The land treatment site is then monitored on a regular basis until the GRO and/or DRO concentration falls below 10 ppm. At that point, the land treatment site is considered clean and can be used for other purposes. Approximately half the sites are found to be clean within one year. The other half take two years, with the rare site taking up to three years.

For a more complete list of site criteria and management requirements, please refer to Guidance Document 3-03 *Land Treatment of Petroleum Contaminated Soil: Land Treatment Sites* and Minn. R. ch. 7037, Petroleum Contaminated Soil Management.

### **Supporting data**

Another frequent misconception about land treatment is that it is an unproven way of dealing with petroleum contaminated soil. Land treatment has been under study since 1946 and has been successfully used for nearly two decades as a way to break down the petroleum in soil removed from the sites of petroleum refineries and leaking underground and aboveground storage tanks. The MPCA completed a study in 1991 and summarized the results. The study involved collecting soil samples ranging from the soil surface to a depth of 48 inches. The study confirmed other research showing that petroleum breaks down in the top layer of soil and does not migrate downward.

### **What other types of treatment or disposal are available?**

There are a number of other methods of dealing with petroleum contaminated soil. The other most common method is thermal treatment where petroleum constituents are essentially burned out of the soil. Thermal treatment facilities are permitted by the MPCA. Composting of petroleum contaminated soil is also becoming more common. Also, if site conditions are appropriate, the petroleum contaminated soil may be able to be treated in place through a venting or bioremediation system.

### ***Web Pages and Phone Numbers***

MPCA Staff:	<a href="http://data.pca.state.mn.us/pca/emplsearch.html">http://data.pca.state.mn.us/pca/emplsearch.html</a>
MPCA Toll Free:	<b>(800) 657-3864</b>
Petroleum Remediation Program Web Page:	<a href="http://www.pca.state.mn.us/programs/lust_p.html">http://www.pca.state.mn.us/programs/lust_p.html</a>
MPCA Information Request:	<a href="http://www.pca.state.mn.us/about/inforequest.html">http://www.pca.state.mn.us/about/inforequest.html</a>
MPCA Petroleum Brownfields Program:	<a href="http://www.pca.state.mn.us/programs/vpic_p.html">http://www.pca.state.mn.us/programs/vpic_p.html</a>
PetroFund Web Page:	<a href="http://www.commerce.state.mn.us/mainpf.htm">http://www.commerce.state.mn.us/mainpf.htm</a>
PetroFund Phone:	<b>(651) 297-1119, or (800) 638-0418</b>
State Duty Officer:	<b>(651) 649-5451 or (800) 422-0798</b>

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